AMENDMENTS TO THE CLAIMS

Please amend claims 22, 27, and 32 as shown in the LISTING OF CLAIMS below. Claims 1-21, 23-26, 28-31, and 33-36 remain unchanged. The LISTING OF CLAIMS will replace all prior versions, and listings, of claims in the present application.

LISTING OF CLAIMS

1. (Original) A circuit for controlling an oscillation amplitude of a crystal oscillator, the crystal oscillator including a crystal resonator, a current source supplying a bias current to said crystal resonator, and an output transistor coupled to said crystal resonator and said current source, said circuit comprising:

a peak detector coupled to an output of the crystal oscillator, detecting a peak voltage of an output signal of the crystal oscillator; and

a controller coupled to said peak detector and to the current source controlling said current source in accordance with a difference between the peak voltage and a target voltage, the target voltage being set to be substantially equal to $2V_{th}$, where V_{th} is a threshold voltage of the output transistor.

2. (Original) A circuit according to claim 1, wherein an average voltage of the output signal is substantially equal to the threshold voltage of the output transistor.

3. (Original) A circuit according to claim 1, wherein said controller includes:

a comparator comparing the peak voltage with the target voltage, and for outputting a control signal in accordance with the comparison; and

a current controller coupled to said comparator controlling a bias current supplied from the current source based on the control signal.

4. (Original) A crystal oscillator comprising:

an input node for receiving an input signal;

an output node for outputting an output signal;

a crystal resonator coupled between said input node and said output node;

a current source coupled to a first supply voltage, for supplying a bias current to said crystal resonator;

a transistor, a gate of said transistor being coupled to said input node, a drain of said transistor being coupled to said current source and said output node, a source of said transistor being coupled to a second supply voltage;

a peak detector circuit coupled to said output node, for detecting a maximum voltage of the output signal at said output node; and

an amplitude control circuit coupled to said peak detector circuit and said current source, for controlling said current source based on the maximum voltage and a target voltage, the target voltage being set to be substantially equal to $2V_{th}$, where V_{th} is a threshold voltage of said transistor.

5. (Original) A crystal oscillator according to claim 4, wherein an average voltage of the output signal is substantially equal to the threshold voltage of said transistor.

6. (Original) A crystal oscillator according to claim 4, wherein said amplitude control circuit includes a comparator coupled to said peak detector and a reference voltage supplying the target voltage, for comparing the maximum voltage with the target voltage and outputting a control signal in accordance with a difference between the maximum voltage and the target voltage.

7. (Original) A crystal oscillator according to claim 6, wherein said current source includes a current source transistor coupled to the first supply voltage, a gate of said current source transistor being controlled by the control signal.

8. (Original) A crystal oscillator according to claim 4, further comprising:

a first capacitor array coupled between said input node and the second supply voltage, said first capacitor array including a first plurality of switched-capacitors and having a first total capacitance; and

a second capacitor array coupled between said output node and the second supply voltage, said second capacitor array including a second plurality of switched-capacitors and having a second total capacitance.

9. (Original) A crystal oscillator according to claim 8, further comprising a frequency control circuit coupled to said first capacitor array and said second capacitor array, said frequency control circuit including:

an input for receiving a frequency control signal; and

a capacitance controller for alternately switching a switched-capacitor in said first capacitor array and a switched-capacitor in said second capacitor array for successive changes in capacitance based on said frequency control signal.

10. (Original) A crystal oscillator according to claim 9, wherein each of said switched-capacitors of said first capacitor array has a capacitance about twice as large as that of a unit capacitor of a conventional capacitor array having a total capacitance substantially same as the first total capacitance.

11. (Original) A crystal oscillator according to claim 10, wherein a total number of the switched-capacitors of said first capacitor array is about a half of a total number of unit capacitors of a conventional capacitor array having a total capacitance substantially same as the first total capacitance.

12. (Original) A crystal oscillator according to claim 9, wherein each of said switched-capacitors of said second capacitor array has a capacitance about twice as large as that of a unit capacitor of a conventional capacitor array having a total capacitance substantially same as the second total capacitance.

13. (Original) A crystal oscillator according to claim 12, wherein a total number of said switched-capacitors of said second capacitor array is about a half of a total number of unit capacitors of a conventional capacitor array having a total capacitance substantially same as the second total capacitance.

14. (Original) A method for controlling a crystal oscillator, the crystal oscillator including a crystal resonator, a current source supplying a bias current to said crystal resonator, and an output transistor coupled to the crystal resonator and the current source, said method comprising:

setting a target voltage substantially equal to $2V_{th}$, where V_{th} is a threshold voltage of the output transistor;

detecting a peak voltage of an output signal of the crystal oscillator;

comparing the peak voltage with the target voltage; and

controlling the current source in accordance with a difference between the peak voltage and a target voltage, thereby controlling an amplitude of the output signal.

15. (Original) A method according to claim 14, wherein an average voltage of said output signal is substantially equal to the threshold voltage of said output transistor.

16. (Original) A method according to claim 14, wherein said current source includes a current source transistor coupled to a supply voltage, and said controlling includes:

generating a control signal in accordance with said comparing; and

controlling a gate bias voltage of the supply current transistor based on the control signal.

17. (Original) A method according to claim 14, wherein said crystal oscillator is coupled between an input node and an output node, said method further comprising:

providing a first capacitor array between the input node and a second supply voltage, the first capacitor array including a first plurality of switched-capacitors;

providing a second capacitor array between the output node and the second supply voltage, the second capacitor array including a second plurality of switched-capacitors;

receiving a frequency control signal; and

alternately switching a switched-capacitor in the first capacitor array and a switched-capacitor in the second capacitor array based on the frequency control signal.

18. (Original) An apparatus for controlling a crystal oscillator, the crystal oscillator including a crystal resonator, a current source supplying a bias current to the crystal resonator, and an output transistor coupled to the crystal resonator and the current source, said apparatus comprising:

means for setting a target voltage substantially equal to $2V_{th}$, where V_{th} is a threshold voltage of the output transistor;

means for detecting a peak voltage of an output signal of the crystal oscillator; and

means for controlling the current source in accordance with a difference between the peak voltage and a target voltage, thereby controlling an amplitude of the output signal.

19. (Original) An apparatus according to claim 18, wherein an average voltage of said output signal is substantially equal to the threshold voltage of said output transistor.

20. (Original) An apparatus according to claim 18, wherein said means for controlling includes:

means for comparing the peak voltage with the target voltage;

means for generating a control signal in accordance with said comparison; and

means for controlling a supply current from the current source based on the control signal.

21. (Original) An apparatus according to claim 18, wherein said crystal oscillator is coupled between an input node and an output node, said apparatus further comprising:

first means for providing a first plurality of switched-capacitors between the input node and a reference voltage;

second means for providing a second plurality of switched-capacitors between the output node and the reference voltage;

means for receiving a frequency control signal; and

means for alternately switching a switched-capacitor in said first means and a switched-capacitor in said second means based on the frequency control signal.

22. (Currently Amended) A circuit for controlling a frequency of a crystal oscillator, the crystal oscillator being coupled between an input node and an output node, said circuit comprising:

a first capacitor array coupled between the input node and a reference voltage, said first capacitor array including a first plurality of switched-capacitors and having a first total capacitance;

a second capacitor array coupled between the output node and the reference voltage, said second capacitor array including a second plurality of switched-capacitors and having a second total capacitance;

an input for receiving a frequency control signal; and

a capacitance controller coupled to said first capacitor array and said second capacitor array, said capacitance controller ~~for alternately~~ switching a switched-capacitor in said first capacitor array and a switched-capacitor in said second capacitor array alternately to each other based on the frequency control signal such that the switched-capacitor in said first capacitor array and the switched-capacitor in said second capacitor array are not switched at the same time.

23. (Original) A circuit according to claim 22, wherein each of said switched-capacitors of said first capacitor array has a capacitance about twice as large as that of a unit capacitor of a conventional capacitor array having a total capacitance substantially same as the first total capacitance.

24. (Original) A circuit according to claim 23, wherein a total number of said switched-capacitors of said first capacitor array is about a half of a total number of unit capacitors of a conventional capacitor array having a total capacitance substantially same as the first total capacitance.

25. (Original) A circuit according to claim 22, wherein each of said switched-capacitors of said second capacitor array has a capacitance about twice as large as that of a unit capacitor of a conventional capacitor array having a total capacitance substantially same as the second total capacitance.

26. (Original) A circuit according to claim 25, wherein a total number of said switched-capacitors of said second capacitor array is about a half of a total number of unit capacitors of a conventional capacitor array having a total capacitance substantially same as the second total capacitance.

27. (Currently Amended) A method for controlling an oscillation frequency of a crystal oscillator, said crystal oscillator being coupled between an input node and an output node, said method comprising:

providing a first capacitor array having a first total capacitance, coupled between the input node and a reference voltage, the first capacitor array including a first plurality of switched-capacitors;

providing a second capacitor array having a second total capacitance, coupled between the output node and a reference voltage, the second capacitor array including a second plurality of switched-capacitors;

receiving a frequency control signal; and

~~alternately~~ switching a switched-capacitor in the first capacitor array and a switched-capacitor in the second capacitor array alternately to each other based on the frequency control signal such that the switched-capacitor in said first capacitor array and the switched-capacitor in said second capacitor array are not switched at the same time.

28. (Original) A method according to claim 27, wherein each of said switched-capacitors of said first capacitor array has a capacitance about twice as large as that of a unit capacitor of a conventional capacitor array having a total capacitance substantially same as the first total capacitance.

29. (Original) A method according to claim 28, wherein a total number of said switched-capacitors of said first capacitor array is about a half of a total number of unit capacitors of a conventional capacitor array having a total capacitance substantially same as the first total capacitance.

30. (Original) A method according to claim 27, wherein each of said switched-capacitors of said second capacitor array has a capacitance about twice as large as that of a unit capacitor of a conventional capacitor array having a total capacitance substantially same as the second total capacitance.

31. (Original) A method according to claim 30, wherein a total number of said switched-capacitors of said second capacitor array is about a half of a total number of unit capacitors of a conventional capacitor array having a total capacitance substantially same as the second total capacitance.

32. (Currently Amended) An apparatus for improving a frequency resolution in tuning an oscillation frequency of a crystal oscillator coupled between an input node and an output node, said method comprising:

first means for providing a first plurality of switched-capacitors between the input node and a reference voltage;

second means for providing a second plurality of switched-capacitors between the output node and a reference voltage;

means for receiving a frequency control signal; and

means for ~~alternately~~ switching a switched-capacitor in said first means and a switched-capacitor in said second means alternately to each other based on the frequency control signal such that the switched-capacitor in said first capacitor array and the switched-capacitor in said second capacitor array are not switched at the same time.

33. (Original) An apparatus according to claim 32, wherein said first means includes means for increasing a capacitance of each of the switched-capacitors therein to a capacitance about twice as large as that of a unit capacitor of a conventional capacitor array having a total capacitance substantially same as the first total capacitance.

34. (Original) An apparatus according to claim 33, wherein said first means further includes means for reducing a total number of the switched-capacitors therein to about a half of a total number of unit capacitors in a conventional capacitor array having a total capacitance substantially same as the first total capacitance.

35. (Original) An apparatus according to claim 32, wherein said second means includes means for increasing a capacitance of each of the switched-capacitors therein to a capacitance about twice as large as that of a unit capacitor of a conventional capacitor array having a total capacitance substantially same as the second total capacitance.

36. (Original) An apparatus according to claim 35, wherein said second means further includes means for reducing a total number of the switched-capacitors therein to about a half of a total number of unit capacitors in a conventional capacitor array having a total capacitance substantially same as the second total capacitance.